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THE GEOLOGIC SECTION IN FAYETTE COUNTY, TEXAS

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THE GEOLOGIC SECTION IN FAYETTE COUNTY, TEXAS

THESIS

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By

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THE GEOLOGIC SECTION IN FAYETTE COUNTY, TEXAS

Introduction

Fayette County, Texas, is on the Colorado River near the western margin of the Gulf Coastal Plain. The surface formations are of Eocene, Oligocene, Miocene, Pliocene, and Recent age. The Colorado River and its tributaries constitute the main drainage system, though some of the other rivers flow directly to the Gulf of Mexico. As Fayette County is on the Coastal Plain, the relief is not great. Small hills are formed by the outcropping sandstones. The soil is generally sandy.

The purpose of this paper is to discuss the outcropping formations of this county, and by means of well logs and samples from wells to endeavor to construct a geologic section in the county.

Surface Geology

Fayette County is located in the belt of Tertiary formations. According to Deussen,[1] the following formations outcrop: Yegua formation, Fayette sandstone, Frio clays, Catahoula sandstone, Oakville sandstone, and Lagarto clay. In the Colorado River valley there are Recent clays, sands, and gravels, and in the western portion of the county, there is a deposit of Uvalde or Reynosa gravels. With the exception of the Frio clays, the Uvalde or Reynosa gravels, and the Colorado River deposits, each of the formations forms an outcropping belt striking northeast-southwest across the county. The Yegua belt, which is the widest, almost coincides with the northwestern boundary of the county. The Fayette, Catahoula, Oakville, and Lagarto formations outcrop in varying widths paralleling the Yegua. The Frio, which is found in the southwestern corner of the county, outcrops in a narrow wedge-shaped area. Overlying these formations are accumulations of gravels, sands, and loams. Alluvial deposits occupy the valley of the Colorado River and tributary streams.

The Deposits that are found in Fayette County, either as surface outcrops or beneath the surface in wells, belong to the Tertiary and Quarternary systems, and include the formations shown in the following table:

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1. Deussen, Alexander, Geology of the Coastal Plain of Texas West of the Brazos River, U. S. Geol. Survey Prof. Paper 126, 1924, map.

Formations found in Fayette County

	Quarternary	Recent			
		Pliocene	Reynosa?		
			Lagarto		
		Miocene	Oakville		
		Oligocene	Jackson	Frio	
				Fayette	
		Eocene	Claiborne	Yegua	
Cenozoic	Tertiary			Cook Mountain	Crockett
					Sparta
				Mount Selman	Weches
					Queen City
					Reklaw
					Carrizo
			Wilcox	Indio	

The surface distribution of these formations according to Deussen[2] is shown on the accompany9ng map. (PlateII)

2. Ibid.

Description of the formations found in
Fayette County

Tertiary System
Eocene Series
Wilcox Group

The Wilcox group was named by Crider[3] after Wilcox County, Alabama, where it is characteristically exposed. G.D. Harris[4] first recognized and described the formation in 1894, when he named it "Lignitic Stage." Dall[5] in 1896 called this same horizon the Chickasaw. Veatch[6] called the formation that he described in northern Louisiana and southern Arkansas the Sabine. He says it differs from the Midway by the amount of lignitic material and fossil leaves. He made a correlation of this formation with the Lignitic of Alabama. The Chickasaw was neither stratigraphically nor historically appropriate as a name; the Lagrange, another name applied to these beds, had already been given to another formation;

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3. Crider, A.F., Geology and Mineral Resources of Mississippi, U. S. Geol. Survey Bull. 283, 1906, pp. 25-28.

4. Harris, G.D., The Tertiary Geology of Southern Arkansas, Arkansas Geol. Survey Ann. Rept for 1892, vol.2, 1894, p. 55.

5. Dall, W.H., A Table of North American Tertiary Horizons correlated with one another and with those of Western Europe, with Annotations, U.S.Geol. Survey Eighteenth Ann. Rept., pt. 2, 1898, pp. 344-345.

6. Veatch, A.C., Geology and Underground Water Resources of Northern Louisiana and Southern Arkansa, U.S. Geol. Survey Prof. Paper 46, 1906, pp. 34-36.

a lack of marine fossils of the Mansfield and Camden localities prevented the use of these places as type localities. The formation was named Sabine from the Sabine River, where there is a typical development of the beds in Sabine County, Texas, and Sabine Parish, Louisiana, and also a noteworthy exposure at Sabinetown Bluff. Lignitic is a lithologic, not a geographic name and it therefore is not in accord with the rules of geologic nomenclature. Chickasaw had been used previously by Hilgard[7] for beds which he called Northern Lignitic, and in which he included beds belonging to Wilcox, Claiborne, and Jackson age. In 1890, Penrose[8] applied the term Sabine River Beds to beds partly Claiborne in age, and this use of the term had precedence over that of Veatch. Wilcox is therefore used in this paper to include beds overlying the Midway and underlying the Claiborne.

According to Deussen[9], beds now considered as Wilcox have been previously referred to as--

Northern Lignitic in Mississippi (included also the Midway). Hilgard, E. W., Report on the geology and agriculture of the state of Mississippi, 1860, pp. 110-123, and map.

Lagrange group (included portions of all the Eocene

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7. Hilgard, E.W., Report on the Geology and Agriculture of the State of Mississippi, 1860, pp. 110-123, and map.

8. Penrose, R.A.F., jr., A Preliminary Report on the Geology of the Gulf Tertiaries of Texas from Red River to the Rio Grande, Texas Geol. Survey First Ann. Rept., 1890, pp. 22-47.

9. Deussen, Alexander, Geology and Underground Waters of the Southeastern Part of the Texas Coastal Plain, U. S. Geol. Survey Water-Supply Paper 335, 1914, pp. 38-39

beds above the Midway). Safford, J. M., On the Cretaceous and Superior formations of western Tennessee: Am. Jour. Sci., 2d. ser., vol. 37, 1864, pp. 369-370.

Lignitic formation in Alabama and Mississippi (included also the underlying Midway as here recognized). Conrad, T.A., Observations on the Eocene lignite formations of the United States: Proc. Acad. Nat. Sci. Philadelphia, vol. 17, 1865.

Mansfield group (included only a portion of the Wilcox as here recognized; referred by Hilgard to the Vicksburg). Hilgard, E.W., Summary of results of a late geological reconnaissance of Louisiana: Am. Jour. Sci., 2d. ser., vol. 48, 1869, p. 340.

Eolignitic (included also the Midway). Heilprin, Angelo, Notes on the Tertiary geology of the southern United States: Proc. Acad. Nat. Sci. Philadelphia, 1881, vol. 33, p. 159.

Lignitic in Alabama (included also the Midway). Smith, E.A., and Johnson, L.C., Tertiary and Cretaceous strata of the Tuscaloosa, Tombigbee, and Alabama rivers: Bull. U. S. Geol. Survey No. 43, 1887, pp. 38-71.

Timberbelt or Sabine River beds in Texas (included also a portion of the Claiborne). Penrose, R.A.F., jr., A preliminary report on the geology of the Gulf Tertiaries of Texas from Red River to the Rio Grande: First Ann. Rept. Geol. Survey Texas, 1890, pp. 22-47.

Lignitic beds in Texas. Kennedy, William, A section from Terrell, Kaufman County, to Sabine Pass on the Gulf of Mexico: Third Ann. Rept. Geol. Survey Texas, 1892, p. 50; also, The Eocene Tertiary east of the Brazos River: Proc. Acad. Nat. Sci. Philadelphia, 1895, pp. 134-144.

Camden series in Arkansas (included the fossiliferous Jackson, the Wilcox as hence recognized, and portion of the Cretaceous). Hill, R. T., Neozoic geology of southwestern Arkansas: Rept. Geol. Survey Arkansas, vol. 2, 1888, pp. 48-53.

Lower Lignitic in northern Louisiana. Lerch, Otto, A preliminary report upon the hills of Louisiana: Bull. Louisiana Experiment Station, 1893, pt. 2.

Lignitic in Alabama (included the upper portions of the Midway, but not the lowest portion). Smith, E.A., Johnson, L.C. and Langdon, D.W., jr., Report on the geology of the Coastal Plain of Alabama: Geol Survey Alabama, 1894.

Lignitic (represents the exact equivalent of the Wilcox as here recognized). Harris, G. D., On the geological position of the Eocene deposits of Maryland and Virginia: Am. Jour. Sci., 3d. ser., vol. 47, 1894, pp. 391-394; also, A preliminary report on the geology of Louisiana: Rept. Geol. Survey Louisiana, 1899, pp. 64-73; also, The geology of the Mississippi embayment with special reference to the State of Louisiana: Rept. Geol. Survey Louisiana, 1902, pp. 11-17; also, The Tertiary geology of southern Arkansas; Second Ann. Rept. Arkansas Geol. Survey, 1894, pp. 55 et seq.; also, The Lignitic stage: Bull. Am. Paleontology vol. 3, No. 9, 1897, p. 202.

Chickasawan stage (included the same devision of the Eocene here called Wilcox). Dall, W.H., A table of North American Tertiary horizons correlated with one another and with those of western Europe, with annotations: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 2, 1898, pp. 334-345.

Sabine formationsin Texas and Louisiana (identical with the beds here called Wilcox). Veatch, A.C., Geollgy and underground water resources of northern Louisiana and southern Arkansas: Prof. Paper U. S. Geol. Survey No. 46, 1906, pp. 34 et seq.

Wilcox formation (Idendical with the beds given the samd name in this report). Crider, A. F., Geology and mineral resources of Mississippi: Bull. U. S. Geol. Survey No. 283, 1906, pp. 25-28: Smith, E. A., The underground water resources of Alabama: Geol. Survey Alabama, 1907, p. 5.

The formation consists of deposits of shallow water origin, lenticular beds of sand, large leaf bearing, calcareous sandstone concretions, sandstones, clays, sandy clays, lignites, and cross-bedded sands and sandstones. This shallow water deposition is indicated by the plant remains The increasing thickness near the center of the East Texas geosyncline and the shallow water nature of the sediments indicates deposition in a steadily subsiding basin.

Indio Formation

The Wilcox group has been divided into two or three formations. In the eastern portion of the state it was originally divided into the Indio and Carrizo. Trowbridge[10] in 1923 divided the Wilcox into three formations, the Indio, the Carrizo, and the Bigford. Later studies have placed the Carrizo in the Claiborne group rather than in the Wilcox.

The Indio formation overlies the Midway conformably and underlies the Carrizo sandstone undonformably. It consists of thin-bedded and laminated argillaceous sands and arenaceous shales with layers of massive clay and lenses and layers of sandstone. Shales and clays are greenish or bluish gray and light chocolate brown, bearing gypsum crystals. The sandstones are gray, yellow, green, brown, not cross-bedded, and variously textured. Lignite is abundant and petrified wood is associated with the sand. Concretions of calcareous and arenaceous materials are scattered. Though most of the beds are of shallow-water origin, along the Sabine River, in Sabine County, there are fossilliferous beds of marine origin. This shallow water deposition is shown by the lignite, cross-bedding, and an abundance of fossil leaves and plants. Towards the Gulf, the formation probably becomes marine, with typical deep water formations.

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10. Trowbridge, A. C., A Geologic Reconnaissance in the Gulf Coastal Plain of Texas near the Rio Grande, U. S. Geol. Survey Prof. Paper 131. pp. 69-91, 1923.

Claiborne Group

The Claiborne group is subdivided into the Mount Selman, Cook Mountain, and Yegua. The first two are subdivided into several members.

	Yegua	
Claiborne	Cook Mountain	Crockett Sparta
		Weches
	Mount Selman	Queen City Reklaw Carrizo

The Group contains the "most persistent marine beds of the Coastal Plain, extending from Maryland to the Rio Grande." It is very fossiliferous. Conrad[11] first proved the presence of Eocene in the Gulf States by these beds from which he collected at Claiborne Bluff in Alabama. He named these beds the Claiborne. The lower two divisions are mainly marine, with some non-marine phases, but the upper, the Yegua, is lignitiferous and contains no marine fossils, except perhaps in a

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Conrad, T.A., Eocene Fossils of the Claiborne, with observations on this formation in the United States; Fossil Shells of the Tertiary formations of North America, vol. 1, No. 3, 1835, pp. 29-36. (See Harris's republication of Conrad's Fossil Shells 1893, pp. 75-84.

few places. The lower portion, with the exception of the Carriso, is very glauconitic.

The partial synonymy of the Claiborne given below is from Veatch's[12] Report on the Underground Water Resources of Northern Louisiana and Southern Arkansas.

Claiborne stage, Dall, (Eighteenth Ann. Rept. U.S. Geol. Survey, pt. 2, 1898, pp. 342-344), except the White Bluff beds.

Claiborne (sand) Lower Claiborne, Harris, (Am. Jr. Sci., 3d. ser., vol. 47, 1894, p. 304), except the White Bluff beds.

Claiborne sand + Ostrea sellaeformis beds + Lisbon beds + Buhrstone, Harris (Am. Jour. Sci., 3d. ser., vol. 47, 1894, p. 304.)

Claiborne (sand) + Buhrstone, Smith and Johnson (Bull. U.S. Geol. Survey, No. 43, 1887, p. 18)

Claiborne proper (including the Claiborne sand and Ostrea sellaeformis beds) + Buhrstone, Smith, Johnson, and Langdon (Geology of the Coastal Plain of Alabama, Geol. Survey Alabama, 1894, pp. 27, 122, 124, geologic map of Alabama, 1894).

Claiborne stage or Claiborne group (siliceous Claiborne + calcareous Claiborne), Hilgard, (Geology of Mississippi, 1860, pp. 108, 123-128).

Clairbornian, Heilprin (Proc. Philadelphia Acad. Nat. Sci, 1882, p. 184; Contributions to Tertiary geology and paleontology of the United States, Philadelphia, 1884, p. 30), which is exactly equivalent of the Claiborne sand.

Lower Claiborne, Kennedy, (Proc. Philadelphia Acad. Nat. Sci. for 1895, 1896, p. 92), which includes part of the Jackson and basal Oligocene beds.

Cooks Mountain beds + Mount Selman beds (Marine deposits or Marine beds) Kennedy, (Third Ann. Rept. Geol.

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12. Veatch, A.C., Geology and Underground Water Resources of Northern Louisiana and Southern Arkansas, U. S. Geol. Survey, Prof. Paper 46, 1906, pp. 34-36

Survey Texas, 1892, p. 45; Bull. U.S.Geol. Survey No. 212, pl. 2, 1903) which includes also the portion of the Sabine which contain marine fossils.

Lower Claiborne + Cockfield Ferry beds, Vaughan (Bull. U.S. Geol. Survey No. 142, 1898, p. 21)

Lower Claiborne, Harris and Veatch, (Geol. Survey Louisiana Rept. for 1899, (1900) pp. 73-89, geologic map).

Lower Claiborne + Cockfield, Harris (Geol. Survey Louisiana, Rept of 1902, (1902), pp. 17-21).

Mount Selman Group

The beds now included in the Mount Selman were first described by L. C. Johnson[13] in 1888. Penrose[14] in 1889, in describing the beds he called the Sabine River beds, also described part now known as Mount Selman. In 1891 these beds were divided by Kennedy[15] into the Lignitic group and the Marine Beds. The latter he divided into two parts, of which he tentatively called the basal the Mount Selman series, from its greatest development in Cherokee County. These beds are correlated with those Harris[16] described as the Lower Claiborne

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13. Johnson, L.C., The Iron Regions of Northern Louisiana and Eastern Texas, 50th Cong., 1st. sess., H.Ex. Doc. 195, pp. 1921, 1889.

14. Penrose, R.A.F., jr., A Preliminary Report on the Geology of the Gulf Tertiaries of Texas from Red. River to the Rio Grande, Texas Geol. Survey, First Ann. Rept, 1890, p. 54.

15. Kennedy, William A., A Section from Terrell, Kaufman County, to Sabine Pass on the Gulf of Mexico, Texas Geol. Survey Third Ann. Rept., pp. 52-54, 1892.

16. Harris, G.D., and Veatch, A.C., A Preliminary Report on the Geology of Louisiana, Louisiana Geol. Survey Rept., pp. 73-89, 1899.

or the St. Maurice formation.

The Mount Selman lies unconformably above the Indio of the Wilcox group and conformably below the Cook Mountain group. The beds consist of brown sands, blue clays, greensands, glauconitic sandstones, and nodular and laminated iron ores overlying the clear quartz sands and light colored clays of the lower part. Fossils, including Venericardia planicosta Lamarck, Plejona petrosa Conrad, Cornulina armigera (Conrad) are not numerous nor characteristic.

Carrizo Sandstone

The Carrizo sandstone was first described by Owen[17] in a letter quoted in the First Annual Report of the Texas Geological Survey as follows:

> ... the outcrop of a sand nearly 200 feet thick. This sandstone had a monoclinal dip to the southeast. It is a very loose, coarse, friable sand and free from any deleterious salts and is an inexhaustible reservoir capable of furnishing water sufficient for irrigating purposes.

Vaughan[18] in 1900, in describing the formation, said that the beds appeared as ripple-marked brown sandstone, disintegrating rapidly from a gray sandstone to coarse, loose, brown,

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17. Owen, J., Letter in Texas Geol. Survey, First Rept. of Progress, 1889, p. 70.

18. Vaughan, T. W., Reconnaissance in the Rio Grande Coal fields of Texas, U.S. Geol. Survey Bull. 164, 1900, p. 45.

crystalline sand. Dumble[19] in 1903 said that the beds described by Owen were a stratigraphical equivalent of the Queen City beds of Kennedy, and were made up of white or yellow sands and sandy clays, ferruginous nodules, concretions and laminae, pyrite, calcareous sands, and buff sandstones. He included these in the Lignitic stage, which is Wilcox in age. Eight year later Dumble[20] published the following:

> In a recent study of the Rio Grande region, Mr. W. Kennedy finds that in this section, instead of being somewhat similar in composition to the top of the Lignitic beds and lying in apparent conformity with them, as in eastern Texas, the Carrizo sands are here materially different from the underlying Lignitic, and that while the Lignitic shows a rather strong dip for the Tertiary the Carrizo sandstones lie at a very gentle inclination. Indeed, these sandstones not only lie unconformably on the Lignitic, but overlap both it and the underlying Midway and are found resting upon the Escondido or upper Cretaceous sediments in many places...
>
> From these facts it will be seen that the Carrizo sands are not a part of the Lignitic, as formerly supposed, but that in reality they correspond both in position and composition with the Buhrstone of the Alabama section, of which we therefore consider them the equivalent, and form the base of the Claiborne series or the Middle Eocene.

Berry[21] in 1921 placed the Carrizo in the Wilcox on the basis of paleobotanical studies. According to a recent article

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19. Dumble, E.T., The Geology of Southwestern Texas, Am. Inst. Min. Eng. Trans., vol. 33, 1903, pp. 929-930.

20. Idem., The Carrizo Sands, Texas Acad. Sci. Trans. vol. 11, 1911, pp. 52-53.

21. Berry, E. W., Additions to the Flora of the Wilcox Group, U.S. Geol. Survey Prof. Paper 131-A, 1922

by Ellisor[22], there is a fine-textured, clean, white micaceous sandstone, lying below the Reklaw and above the Wilcox, which can be traced into the Carrizo sands of Milam County. Due to lithologic differences an an unconformable relationship with the Wilcox, the Carrizo is placed in the Claiborne.

The Carrizo lies unconformably in places above the Indio. There is considerable overlap in Southwest Texas. The lower part is coarsely crystalline, brown sandstone, cross-bedded, and calcareous in places. The upper part, found in Southwest Texas only, is gray, fine-grained, micaceous,sandstone, calcareous in spots. The formation thickens westward, varying from ten to six hundred and fifty feet. This great variation can only be explained by unconformable relationships. After the close of Wilcox times, the East Texas Basin subsided slightly. The material brought down then was such as to produce typical Cliaborne lithology. The Carrizo was laid down in a shallow basin. No lignite is known in the Carrizo. Light colored clays and volcanic ash are present locally. A hard ferruginous sandstone has been formed in place, probably by circulating ground waters.

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22. Ellisor, Alva Christine, Correlation of the Claiborne of East Texas with the Claiborne of Louisiana, Bull. Amer. Assoc. Petrol. Geol., Vol. 13, No. 10, 1929, p. 1343.

Reklaw Formation

The Reklaw formation was recognized by Kennedy,[23] but was placed above the Queen City rather than below it due to the fact that he confused the Carrizo and the Queen City sands. The name Reklaw was proposed by Wendlandt and Knebel[24] from the village of Reklaw, in Cherokee County, where there are good exposures. Their descriptions of the formation is as follows:

> The Reklaw consists of those glauconites and glauconitic clays above the Carrizo and underlying the sands and clays of the Queen City. Following the shallow Carrizo seas, the basin subsided further and the deposits were probably laid down just beyond the zone of wave action in water not much deeper than 150 fathoms. The basal part of the Reklaw consists of 20-40 feet of brown to dark blue micaceous sandy clay with stringers of glauconite and zones of clay ironstone concretions. Above this zone occurs rather pure clayey glauconite ranging from 4 to 15 feet in thickness, containing plentiful fossils. Above this glauconite is commonly found a brown clay with streaks of sand and greensand and zones of clay iron concretions. The thickness of this clayey zone ranges from almost nothing to more than 100 feet.

The contact between the Reklaw and Queen City is a transitional zone, generally arbitrarily decided. It is usually selected at the point where the glauconite streaks end.

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23. Kennedy, William A., A Section from Terrell, Kaufman County, to Sabine Pass on the Gulf of Mexico, Texas Geol. Survey Third Ann. Rept. 1892, pp. 52-5?

24. Wendlandt, E. A., and Knebel, G. Moses, Lower Claiborne of East Texas, with Special Reference to Mount Sylvan Dome and Salt Movements. Bull. Amer. Assoc. Petrol. Geol., vol. 13, No. 10, 1929, pp. 1352-53.

Queen City Sands

Kennedy[25] first described the Queen City beds in 1892, and named them from the exposures in the neighborhood of Queen City, Cass County. Dumble[26], in his description of the Carrizo, sayd the Queen City beds are the equivalent of direct extension of the C rrizo sands of West Texas. Later work has shown this is not true. The formation comprises those beds overlying the Reklaw and underlying the Weches. It consists of alternating beds of sands, sandy clays, clays, thin beds of lignite, and possibly bentonitic material. The sands are almost pure, cross-bedded quartz sands. Greensand is gound in spots, and is partly cross-bedded, mealy, and sandy. Fossils are not abundant.

Weches Formation

The Weches overlies the Queen City sandstone and unerlies the Sparta sand member. The formation was named by Wendlandt and Knebel,[27] from Weches, Houston County. It consists of a rather glauconitic clay. Toward the north the

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25. Kennedy, William, A Section from Terrell, Kaufman County, to Sabine Pass on the Gulf of Mexico, Texas Geol. SurveyQThird Ann. Rept., 1892, p. 50.

26. Dumble, E.T., Geology of East Texas, Univ. of Texas Bull. 1869, 1918, pp. 61-62.

Wendlandt, E.A. and Knebel, G. Moses, Lower Claiborne of Ea t Texas, with Special Reference to Mount Sylvan Dome and Salt Movements, Bull. Amer. Assoc. Petrol. Geol., vol. 13, No. 10, 1929, pp. 1355-1359.

Weches greensand becomes more sandy and cross-bedded and iron ores are found irregularly through the section. The greenish-blue fossiliferous beds weather to deep reddish-brown with almost complete destruction of the fossils present. Siderite is commonly found. A zone of laminated iron ore is found at the top of the Weches. Concerning the location of this formation in the section, Wendlandt and Knebel[28] say:

> The Weches has commonly been referred to as Cook Mountain. The type locality at Mount Selman is on this deposit, but Kennedy, Deussen, and Dumble repeatedly refer to it as Cook Mountain in other localities.

The rather shallow basin of the Queen City seas subsided enough to cause conditions faforable for glauconite deposition, so that the Weches is remarkable for rather pure clayey glauconite.

Cook Mountain Group

The Cook Mountain was named by Kennedy[29] in 1892, when he divided the Timber Belt beds into the Lignitic and Marine groups. The subdivisions of the Marine he called Mount Selman and Cook Mountain. Penrose,[30] in describing the

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28. Ibid. 1358.

29. Kennedy, William, A Section from Terrell, Kaufman County, to Sabine Pass on the Gulf of Mexico, Texas Geol. Survey Third Ann. Rept, 1892, pp. 47-57.

30. Penrose, R.A.F., jr., A Preliminary Report on the Geology of the Gulf Tertiaries of Texas from Red River to the Rio Grande, Texas Geol. Survey First Ann. Rept, 1890, p. 34.

Timber Belt, gave various sections of the Claiborne, one of which was that of Cook's Mountain, a hill capped by yellow sandstone with many shell casts, located two miles west of Crockett, Houston County. This formation has been spelled Cook's Mountain by Kennedy[31] and Dumble[32]. The term Cook Mountain was used by Deussen in 1914[33] and 1924[34] and by Dumble[35] in 1924. The U. S. Geological Survey uses the term Cook Mountain officially.

The Cook Mountain beds overlie the Mount Selman group and underlie the Yegua formation. They consist of greensands, greensand marls, iron ore, lignite, lignitic clay, clay, sandstone, and sand. The beds are marine except the lignite, lignitic clay, and some of the sands, which are palustrine; they are very fossiliferous. The Cook Mountain and the Mount Selman are very similar and grade into each other. The contact is arbitrary.

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31. Kennedy, William, A Section from Terrell, Kaufman County, to Sabine Pass on the Gulf of Mexico, Texas Geol. Survey Third Ann. Rept. 1892, p. 52.

32. Dumble, E.T., The Geology of East Texas, Univ. of Texas Bull. 1869, 1918, pp. 57, 65-67.

33. Deussen, Alexander, Geology and Underground Waters of the Southeastern part of the Texas Coastal Plain, U.S. Geol. Survey Water-Supply Paper 335, 1914, pp.56-65.

34. Idem., Geology of the Coastal Plain of Texas West of the Brazos River, U. S. Geol. Survey Prof. Paper 126, 1924, pp. 10,64-73.

35. Dumble, E.T., A Revision of the Texas Tertiary Section with Special Reference to the Oil-Well Geology of the Coast Region, Bull. Amer. Assoc. Petrol. Geol., vol. 8, 1924, p. 428

Sparta Sands

The Sparta sands were defined by Vaughan[36] in 1895. Spooner[37] divided the Claiborne into Cane River, Sparta, and St. Maurice. Dumble[38] and Kennedy[39] referred to this formation as the Nacogdoches. The beds defined by them as Nacogdoches are transitional between Cook Mountain and Yegua. The Sparta member consists of those sands and clays overlying the Weches and underlying the Crockett. They are called Sparta because of correlation with beds in Louisiana of the same name. Spooner[40] described the formation as follows:

> ... the Sparta is made up chiefly of sand with interbedded members of laminated, sandy clay. The massive sands are made up of quartz grains, somewhat coarser than found in the Wilcox formation... Massive sands alternate with beds of finely-laminated, sandy clay, in part lignitic and in many places containing fossil leaves. The upper fifty feet of beds contain a considerable amount of lignitic material and some thin lignitic beds... The beds are commonly light-colored but... red and brown beds occur. Fossils are generally absent from the Sparta sand, but a few species of near-shore forms are found near the middle of the formation.

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36. Vaughan, T.W., A Brief Contribution to the Geology and Paleontology of Northwestern Louisiana, U.S.Geol. Survey Bull. 142, 1895

37. Spooner, W.C., Interior Salt Domes of Louisiana, Bull. Amer. Assoc. Petrol. Geol., vol. 10, 1929, pp. 235-236.

38. Dumble, E.T., The Geology of East Texas, Univ. of Texas Bull. 1869, 1918, pp. 79-80.

39. Kennedy, William, A Section from Terrell, Kaufman County, to Sabine Pass on the Gulf of Mexico, Texas Geol. Survey Third Ann. Rept. 1892, pp. 52 and 105.

40. Spooner, W.C., op. cit. p. 236

Crockett Formation

The Crockett formation overlies the Sparta and underlies the Cockfield or Yegua. It was named by Wendlandt and Knebel,[41] who define it as follows:

> The problem of the upper part of the marine Claiborne is one for paleontologist to solve. In Louisiana this series can be divided into the upper Saline Bayou, the middle Milams, and the lower Crockett, all with distinct faunal zones. In Texas these three zones are present in Sabine County, but westward the two upper members are progressively overlapped by the Yegua. Inasmuch as these three zones have not yet been thoroughly investigated, the discussion is primarily about the Crockett. Dumble's type locality of the Yegua in Lee County is Crockett in age... The Crockett formation normally crops out south of the place where the normal gulfward dip commences. The Crockett consists of chocolate brown and gray clay, some beds of fossiliferous glauconite with concretionary zones of fossiliferous brown sandy limestone, thin beds of sand, clay ironstone concretions, and in places is calcareous... The gypsiferous clays south of Crockett in Houston County which Kennedy and Dumble refer to the Yegua, have been found to contain Crockett fossils.

The Crockett is stratigraphically the same as the beds in Louisiana referred to locally as the Minden beds. The contact between the Crockett and Yegua is transitional; in core drilling it is placed at the point where the last macrofossils appear.[42]

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41. Wendlandt, E.A., and Knebel, G. Moses, Lower Claiborne of East Texas, with Special Reference to Mount Sylvan Dome and Salt Movements, Bull. Amer. Assoc. Petrol. Geol., vol. 13, No. 10, 1929, pp. 1360-1361.

42. Ibid. p. 1361.

Yegua Formation

Dumble[43] defined the Yegua in 1892 as follows:

> To this division is referred the lower portion of the deposits heretofore classed as Fayette beds.. Following Cook's Mountain beds there comes a series of deposits made up chiefly of sands, sandy clays, clays, and brown coals.

Vaughan,[44] in 1896, gave the name Cocksfield Ferry to beds which lie--

> conformably above the fossiliferous Lower Claiborne at St. Maurice,... are laminated non-fossiliferous clays or laminated sand and clay, dipping slightly south... The same beds are well exposed at Cocksfield Ferry... For these beds between St. Maurice and Montgomery, coming between the Lower Claiborne and the Jackson, I propose the local name of "Cocksfield Ferry beds."

Veatch[45], in 1906, called these beds Cockfield. In the same year he[46] described the formation in Louisiana. They are lignitiferous sands and clays, extremely similar lithologically to the Sabine, containing no marine molluscs, and are characterized by thin beds of lignite. The Yegua is a near shore deposit, but towards the Gulf it becomes marine in char-

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43. Dumble, E.T., Geology of the Brown Coal Deposits of Texas, Texas Geol. Survey, 1892, p. 148.

44. Vaughan, T.W., A Brief Contribution to the Geology and Plaeontology of Northwestern Louisiana, U.S.Geol. Survey Bull. 142, 1895, pp. 21-22.

45. Veatch, A.C.,A Report on the Underground Waters of Louisiana, Geol. Survey of Louisiana, Rept. of 1905.1905.

46. Idem.Geology and Underground Water Resources of Norther Louisiana and Southern Arkansas, U.S.Gool. Survey, Prof. Paper 46, 1906, p. 37

acter. Dumble[47] in 1918 published his type section of the Yegua near the mouth of Elm Creek on the Yegua River. He also says that the formation is Lower Claiborne in age, apparently marking a shallowing of the Cook Mountain seas. In 1924 he[48] divided the Claiborne into four divisions: Mount Selman, Cook Mountain, Nacogdoches, and Yegua, and called all above the Nacogdoches Yegua (Sparta). The formation consists of alternating light colored to dark sands, and thin bedded, laminated, sandy, chocolate to dark green colored clays, and lignitic clays of palustrine and lacustrine origin. Selenite in veins and masses is found in the clay. Marine fossils are not common.

The synonymy of the Cockfield or Yegua which follows has been taken from articles by Veatch[49], Deussen[50 & 51] and Dumble.[52]

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47. Dumble, E.T., The Geology of East Texas, Univ. of Texas Bull. 1869, 1918, p. 106.

48. Idem., A Revision of the Texas Tertiary Section with Special Reference to the Oil-Well Geology of the Coast Region, Bull. Amer. Assoc. Petrol. Geol., Vol. 8, No. 4, 1924, pp. 424-444.

49. Veatch, A.C., Geology and Underground Water Resources of Northern Louisiana and Southern Arkansas, U.S.Geol. Survey Prof. Paper 46, 1906, p. 37.

50. Deussen, Alexander, Geology of the Coastal Plain of Texas West of the Brazos River, U.S.Geol. Survey Prof. Paper 126, 1924, pp. 75-80.

51. Idem.,Geology and Underground Water of the Southeastern Part of the Texas Coastal Plain, U.S.Geol. Survey Water-Supply Paper 335, 1914, pp. 65-67.

52. Dumble, E.T., loc. cit., p. 424.

Upper Lignitic beds (included Yegua), Lerch , Otto, Preliminary report on the hills of Louisiana south of the Vicksburg, Shreveport, and Pacific Railway to Alexandria, 1893, pp. 82-85.

Cocksfield Ferry beds, Vaughan, T.W., Am. Geol., vol. 15, 1895, p. 220; Bull. U.S.Geol. Survey No. 142, 1896, p. 21.

Lower Claiborne, Harris and Veatch, Geol. Survey Louisiana, Rept. for 1899, (1900), pp. 80-82, which includes also the fossilif rous portion of the Claiborne in Louisiana.

Cocksfield beds, Harris, Geol. Survey Louisiana, Rept. of 1902, 1902, p. 21.

Cocksfield Ferry beds or Cocksfield, Veatch, Geol. Survey Louisiana, Rept of 1902, 1902, pp. 120, 130-131, 141, 152, 160-163.

Yegua, Dumble, E.T., Report on Brown Coal, Geol. Survey Texas, 1892, pp. 148-154; Science, new ser., vol. 16, 1902, pp. 670-671.

Yegua clays, Kennedy, William, Proc. Philadelphia Acad. Nat. Sci., vol. 47, 1895, p. 92, which includes part of the fossiliferous marine Jackson.

Lufkin or Angelina County beds, Kennedy, William, Third Ann. Rept., Geol. Survey Texas, 1892, pp. 45, 58-60, which includes part of the fossiliferous marine Jackson.

Mansfield group, Hopkins, First Ann. Rept. Geol. Survey Louisiana, 1869, 1870, pp. 78-832, which includes the unfossiliferous Sabine.

Northern Lignitic, Hilgard, Geology of Mississippi, 1860, pp. 110-123; Am. Jour. Sci., 3d. ser., vol. 2, 1871, pp. 394-396, which includes also lignitiferous portions of the Sabine and lower Caliborne.

Cockfield member, Veatch, A.C., Geology and Underground Water Resources of Northern Louisiana and Southern Arkansas, U.S. Geol. Survey Prof. Paper 46, 1906, p. 37.

Yegua, Dumble, E.T., A Revision of the Texas Tertiary Section with Special Reference to the Oil-Well Geology of the Coast Region, Bull. Amer. Assoc. Petrol. Geol., vol. 8, No. 4, 1924, pp. 424-444.

Fayette beds, Penrose, R.A.F., jr., A Preliminary Report on the Geology of the Gulf Tertiary of Texas from Red River to the Rio Grand, First Ann. Rept. Geol. Survey

Texas, 1890, pp. 47-58.

Yegua formation, Deussen, Alexand r, Geology and Underground Waters of the Southeastern Part of the Texas Coastal Plain, U.S. Geol. Survey Water*Supply Paper 335, 1914, pp. 65-68; Geology of the Coastal Plain of Texas West of Brazos River, U. S. Geol. Survey Prof. Paper 126, 1924, pp. 75-80.

Jackson Group

The Jackson group was named by Conrad in 1856. The type exposure is near Jackson, the capital of Mississippi. Veatch[53] in 1902 showed that the formation was present in Texas. He found Jackson fossils on the Sabine. The formation lies conformably below the Catahoula and above the Yegua. The Jackson is made up of marine deposits and those laid down in lagoons and swamps. Lignite is present, with terrestrial deposits and deposits from volcanic flows and eruptions. Calcareous concretions replace the clay ironstone and limonitic concretions of the underlying Yegua. The sands vary from very friable to very hard, almost quartzitic sandstones, and are light gray in color and quite fossiliferous. Volcanic ash beds are characteristic. In an article in a recent Bulletin of the American Association of Petroleum Geologists[54] the formation is described. The exposed Jackson is an indu-

53.Veatch, A C., The Geography and Geology of the Sabine River, <u>Louisiana Geol. Survey, Special Rept, No.3,</u> 1902, pp. 131-132.

54.Applin, Esther Richards, Ellisor, Alva C., and Kniker, Hedwig T., Subsurface Stratigraphy of the Coastal Plain of Texas and Louisiana, <u>Bull. Amer. Assoc. Petrol. Geol.</u> vol. 9, 1925, p. 111.

rated, fairly coarse-grained sandstone, with loosely consolidated sands and clays, bearing fossils. Foraminifera are found in the clays. The lower Jackson is sandy and highly unfossiliferous macroscopically and no foraminifera have been found in the surface outcrops. The middle Jackson has a well developed micro-fauna. The upper Jackson is sand largely, with no foraminifera.

After the deposition of the Jackson there was an erosional interval, so that the Fayette is in contact with the Yegua between the Brazos and Trinity Rivers, while the Frio is in contact with the Yegua east of the Neches. Volcanic activity was pronounced during this time and furnished tuff and ashes for deposition. According to Deussen[55] the Jackson formation outcrops in Texas in a wedge-shaped manner. The Jackson group, which is made up of the Fayette and Frio menbers, is found as a belt across the Gulf Coastal Plain.

The synonymy of the Jackson formation given below is partly from Veatch.[56]

Jacksonian stage, Dall, Eighteenth Ann. Rept. U.S.Geol. Survey, pt. 2, 1898, p. 342.

Jackson stage, Harris and Veatch, Geol. Survey

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55. Deussen, Alexander, Geology and Underground Water of the Southeastern Part of the Texas Coastal Plain, U.S.Geol. Survey, Water Supply Paper 335, 1914, map.

56. Veatch, A.C., Geology and Underground Water Resources of Northern Louisiana and Southern Arkansas, U.S. Geol. Survey Prof. Paper 46, 1906, pp. 32.

Louisiana Rept. for 1899, 1900, pp. 89-93; Geol. Survey Louisiana, Rept 1902, 1902, pp. 22-23, 131-132, 141, 158 164-167.

Jackson group, Hopkins, Second Ann. Rept. Geol. Survey Louisiana, 1871, pp. 7-15, map, which includes the Sabine, Cockfield, lower Claiborne, and a part of the Jackson; the remainder of the Jackson is included in his Vicksburg group.

White limestone, Johnson, Report on the iron region of northern Louisiana and eastern Texas, House, Ex. Doc., 50th Cong. 1st sess., No. 195, 1888, map, pp. 14-15, which includes lower Claiborne (in part), Cockfield, Jackson, and Vicksburg(?).

Yegua clays, Kennedy, Proc. Philadelphia Acad. Nat. Sci., vol. 47, 1895, p. 92, which includes the Cockfield.

Yegua, Dumble, Report on Brown Coal, Geol. Survey Texas, 1892, pp. 148-154; Science, new ser., vol. 16, 1902, pp. 670-671, which is regarded as a portion of the Claiborne.

White limestone, Smith, Geology of the Coastal Plain of Alabama, Geol. Survey Alabama, 1894, pp. 107, 232, 376, 492, 495; see also Casey, Proc. Philadelphia Acad. Nat. Sci. for 1901, 1901, pp. 513-518.

Fayette sands, Kennedy, Proc. Philadelphia Acad. Nat. Sci., for 1895, 1896, pp. 92, 95-99; Bull. U.S.Geol. Survey No. 212, 1903, p. 20, pl. 2. These as defined by Kennedy are largely Catahoula (Grand Gulf), but include near the base, Jackson fossils. See Harris, Geol. Survey Louisiana, Rept of 1902, p. 25; Veatch, ibid., p. 133.

Vicksburg, Hilgard, Am. Jour. Sci., 2d. ser., vol. 48, 1869, pp. 340-341; Supplement and Final Report of a Geological Reconnaissance of Louisiana, New Orleans, 1873, pp. 18-18, which includes all the Jackson and Claiborne beds in Louisiana along the Sabine River and a number of Jackson localities in eastern Louisiana.

Jackson group, Lerch, The Hills of Louisiana south of the Vicksburg, Shreveport, and Pacific Railway, 1893, pp. 88-91, which includes only a portion of the lower Claiborne.

Jackson, Deussen, Alexander, Geology and Underground waters of the southeastern part of the Texas Coastal Plain; U.S.Geol. Survey Water-Supply Paper 335, 1914, pp. 67-68.

Jackson, Dumble, E.T., The Geology of East Texas, Univ. of Texas Bull. 1869, pp. 145-183, 1918.

Fayette-Frio, Deussen, Alexander, Geology of the Co stal Plain of Texas West of Brazos River, U. S. Geol. Survey Prof. Paper 126, 1924, pp. 80-95.

Fayette Sandstone

The lo er part of the Jackson, the Fayette sandstone, was described by Penrose[57] in 1890. Dumble[58] in 1892 divided these beds into two parts, The Yegua and Fayette. In 1903 he[59] defined the formatinn, and placed it in the lower Claiborne. Deu sen[60] says that the formation is not lower Claiborne but Jackson in age.

> The evidence at hand does not indicate that the Fayette sandstone is lower Claibonre age. It has not been possible to find the lower Claibonne faunas reported from these sandstones north of the Nueces. Though most of the fossils found are poorly preserved and difficult to identify, there is nothing about them that suggests their affinity with the lower Claiborne. On the contrary, such specimens as have been collected... suggest Jackson affinities rather than Claiborne. Furthermore, the fossil leaves collected from the formation point decidedly to an age later than lower Claiborne. It seems fairly certain, therefore, that the Fayette sandstone is not of the lower Claiborne but of Jackson age... Veatch's statement that "there seems to be no reason for regarding the Grand Gulf sandstoness of Texas as different from the Grand Gulf sandstones of Louisiana and Mississippi" does

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57. Penrose, R.A.F., jr., A Preliminary Report on the Geology of the Gulf Tertiaries of Texas from Red River to the Rio Grande, Texas Geol. Survey First Ann. Rept. 1890, p. 47.

58. Dumble, E.T., Report on the Brown Coal and Lignite of Texas, Texas Geol. Survey, pp. 148-154, 1892.

59. Idem., Geology of Southwestern Texas, Am. Inst. Min. Eng. Trans., vol. 33, 1903, p. 32.

60. Deussen, Alexander, Geology of the Coastal Plain of Texas West of Brazos River, U.S.Geol. Survey, Prof. Paper 126, 1924, pp. 80, 83-84.

> seem to be in accord with the facts. If the occurrence of the fossil Ostrea georgiana is significant, the Fayette sandstone of southwest Texas belongs entirely to the Jackson epoch, for this fossil occurs above them, in the base of the Frio Clay.... Deussen and Matson in western Louisiana and eastern Texas have shown that fossiliferous gray sandstone, chocolate-colored and lignitic clay and lignite, and quartzite are found at the base of the formation that has been mapped there as the Catahoula, lying above fossiliferous Jackson clays. The flora and fauna of these beds indicate their close association with the Fayette beds of Texas... they appear to represent the eastern extensionnof the Fayette sandstone of Texas... Heretofore been included with the Catahoula. It would therefore seem that the Fayette sandstone is a stratigraphic unit of Jackson age, which has its greatest development in southwestern Texas and becomes thinner eastward, toward Louisiana.

The Fayette sandstone is named from Fayette County, where the formation is typically exposed. It overlies the Yegua, and, west of the Colorado River, it is overlain conformably by the Frio clay. The formation is made up of gray sandstone, flaggy in places, massive in others; sand; brown and chocolate colored clay; lignitic clay; and lignite. Silicified and opalized wood is present and fossils are found in parts of the section. The lignite is not as abundant as in the Wilcox; lignitiferous clay is more common. Volcanic ash is found interstratified with clay. The abundant leaves of land plants and lignitic streaks indicate low-lying coastal plain or near-shore deposition. The cross-bedded sandstone indicated current action. Reworked foraminifera from Cretaceous formations are present.

Deussen[61] gives a partial synonymy of the Fayette sandstone:

Fayette beds (included the Yegua, Fayette, Frio Oakville, Lapara, and Lagarto formations), Penrose, R.A.F., jr., A Preliminary report on the geology of the Gulf Tertiaries of Texas, from Red River to the Rio Grande: Texas Geol. Survey First Ann. Rept., pp. 47-58, 1890.

Fayette division: Dumble, E.T., Report on the brown coal and lignite of Texas, Texas Geol. Survey, pp. 154-157, 1892.

Fayette sands (included the Catahoula of East Texas): Kennedy, William, A section from Terrell, Kaufman County, to Sabine Pass on the Gulf of Mexico: Texas Geol. Survey, Third Ann. Rept., pp. 60-62, 113-116, 1892.

Welborn beds: Kennedy, William, Report on Grimes, Brazos, and Robertson counties: Texas Geol. Survey, Fourth Ann. Rept., pp. 45-46, 1893.

Fayette sands (included the Catahoula of east Texas): Kennedy, William, The Eocene Tertiary of Texas east of the Brazos River: Acad. Nat. Sci. Philadelphia Proc., 1895, pp. 95-99.

Grand Gulf (included the Fayette) Veatch, A.C., The geography and geology of the Sabine River, Louisiana Geol. Survey, pp. 132-134, 141, 1902.

Fayette sands (included the Catahoula of east Texas): Hayes, C.W., and Kennedy, William, Oil fields of the Texas-Louisiana Gulf Coastal Plain, U.S.Geol. Survey Bull. 212, pp. 21-23, 42-61, 1903.

Fayette sands: Dumble, E.T., Geology of southwestern Texas, Am. Inst. Min. Eng. Trans., vol. 33, pp.32-40, 1903.

Catahoula formation (included the Fayette): Veatch, A.C., Geology and underground water resources of northern Louisiana and southern Arkansas: U.S. Geol. Survey Prof. Paper 46, pp. 42-43, 1906.

Catahoula sandstone(included the Fayette):Deussen,

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61. Deussen, Alexander, Geology of the Coastal Plain West of the Brazos River, U.S.Geol. Survey Prof. Paper 126, 1924, p. 80.

Alexander, Geology and underground waters of the southeastern part of the Texas Coastal Plain: U.S. Geol. Survey Water-Supply Paper 335, pp. 68-72, 1914.

Frio Clay

The Frio clay was named by Dumble[62] in 1894 from Exposures on the Frio and Neches Rivers. The formation is a part of the Jackson group and overlies the Fayette sandstone between the Brazos and Trinity Rivers and the Yegua formation east of the Neches. It underlies the Catahoula conformably in the eastern part of the state, and the Oakville unconformably in the western part. Dumble[63] described the formation as follows:

> The clays are dark colored, greenish gray, red or blue, usually massive, with quantities of gypsum and with calcareous concretions arranged in lines, giving them a stratified appearance. The sandy beds are laminated and bedded, green, red, or blue in color, and interbedded with brown and green sandstone, which is concretionary and, in places, highly indurated. Brown sands overlie these, and are followed by laminated chocolate clays containing concretions of crystalline limestone with manganese dendritions. The fossils are not very abundant.

In regard to correlation, the scarcity of fossils makes exact determination difficult. The upper part may be Oligocene, but until better evidence is available, it is classed as Hackson (upper Eocene) age.

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62. Dumble, E.T., The Cenozoic deposits of Texas, Jour. Geol., vol., 2, 1894, pp. 554-555.

63. Ibid., p.554.

Oligocene Series

Catahoula Sandstone

The Catahoula formation was named by Veatch[64] in 1906 from Catahoula Parish, Louisiana, which is directly across the Mississippi from Grand Gulf. In Texas, the formation overlies conformably the Fayette sandstone in Washington and Fayette Counties, and underlies unconformably the Oakville sandstone south of Lavaca County. The Catahoula is made up of blue quartzitic sandstone, green, blue, and brown clay; gray calcareous, cross-bedded sandstone; lenses of white kaolin-like clay; green sandy clay; and gray sandstone. Petrified wood is abundant. Marine fossils have not been found in the formation. It is a continuation of the Catahoula sandstone of eastern Texas and Louisiana. As the Catahoula sandstone of eastern Texas disappears west of the Colorado River, near the Guadalupe River, it may be a time equivalent of part of the Frio clay.

Veatch[65] gives a partial synonymy of the Catahoula formation.

> Grand Gulf sandstone, Wailes (Agriculture and Geology of Mississippi, 1857, pp. 216-219). Includes typical Grand Gulf sandstone and (erroneously) some consolidated Claiborne and Lafayette.

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64. Veatch, A.C., Geology and Underground Water Resources of Northern Louisiana and Southern Arkansas, U.S. Geol. Survey Prof. Paper 46, p. 42-43, 1906.

65. Ibid., p. 42.

Grand Gulf group, Hilgard, (Report on Geology and Agriculture of Mississippi, 1860, pp. 147-154), which includes the Catahoula, Fleming, and Pascagoula formations.

Typical Grand Gulf, Dall, (Eighteenth Ann. Rept. U.S. Geol. Survey, pt. 2, 1898, table fading p. 334.)

Grand Gulf proper, Harris, (Geol. Survey Louisiana, Rept. of 1902, p. 28).

Grand Gulf beds, Harris, (ibid.).

Grand Gulf, Veatch (Geol. Survey Louisiana, Rept. of 1902, pp. 120, 132-135).

Fayette beds, Penrose (First Ann. Rept. Geol. Survey Texas, 1890, pp. 47-58), which are a composite including Claiborne beds in their type locality and Catahoula and Fleming beds in east Texas.

Fayette beds, Dumble (Jour. Geol., vol. 2, 1894, pp. 552-554; Science, new ser., vol. 16, 1902, p. 671), which are Claiborne.

Fayette sands, Kennedy, (Third Ann. Rept. Texas Geol. Survey, 1892, pp. 60-62; Bull. U.S. Geol. Survey No. 212, 1903, pp. 20, 21-22), which includes a portion of the Jackson. (See Geol. Survey Louisiana, Rept. of 1902, pp. 25,132, 133.)

Oakville, Dumble, (Science, new ser., vol. 16, 1902, pp.670-671). This correlation, while suggestive, needs further evidence to verify it.

Miocene Series

Oakville Sandstone

The Oakville sandstone was named in 1894 by Dumble.[66] The formation overlies unconformably both the Catahoula and Frio formations. North of the Guadalupe River it underlies the Lagarto clay unconformably. Dumble described the forma-

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[66] Dumble, E.T., The Cenozoic Deposits of Texas, Jour. Geol. vol., 2, 1894, pp. 556-559.

tion as consisting of claystones interbedded with porcelaneous and siliceous rocks. The siliceous parts are flinty or opaline. Seams of ferruginous matter are present. Aragonite and calcite are found in spots. The sandstone, which is also found, is gray, soft and clacareous in places and hard in others. It is generally cross-bedded or its bedding is very irregular. Apparently the Oakville was deposited by rapid currents in shallow water. Fossils include: Protohippus medius Cope, P. perditus Leidy, P. placidus Leidy, and Aphelops meridianus Leidy. This fauna indicated Miocene age.

Deussen[67] gives a partial synonymy of the Oakville sandstone:

Miocene Tertiary strata: Shumard, B.F., Acad. Sci. St. Louis Trans., vol. 2, pp. 140-141, 1868.

Grand Gulf: Loughridge, R.H., Report on the cotton production of the State of Texas with a dixcussion of the general agricultural features of the State: Tenth Census U.S., vol. 5, pt. 1, p. 679, 1884.

Fayette beds (included the Megua, Fayette, Oakville, Frio, Lapara, and Lagarto formations): Penrose, R.A.F., jr., A preliminary report on the geology of the Gulf Tertiaries of Texas from Red River to the Rio Grande: Texas Geol. Survey First Ann. Rept., pp. 47-58, 1890.

Navasota beds (included Oakville sandstone and Lagarto clay): Kennedy, William, Report on Grimes, Brazos, and Robertson counties: Texas Geol. Survey Fourth Ann. Rept., pp. 9-15, 43-44, 1893.

Oakville beds: Dumble, E.T., The Cenozoic deposits of Texas: Jour. Geology, vol. 2, pp. 556-559, 1894; Geology of southwestern Texas: Am. Inst. Min. Eng. Trans., vol. 33,

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67. Deussen, Alexander, Geology of the Coastal Plain of Texas West of Brazos River, U.S. Geol Survey Prof. Paper 126, 1924, p. 97.

pp. 43-60, 1903.

Dewitt formation (included the Oakville, Lapara, and Lagarto formatinns): Deussen, Alexander, Geology and underground waters of the southeastern part of the Texas Coastal Plain: U.S.Geol. Survey Water-Supply Paper 335, pp. 74-76, 1914.

Pliocene Series

Lagarto Clay

The Lagarto was named in 1894 by Dumble[68] from exposures on Lagarto Creek in Live Oak County. It overlies the Oakville unconformably and underlies the Reynosa unconformably. Dumble[69] describes the formation as follows:

> .... a series of sands and clays... light colored clays-- lilac, lavender, sea-green, greenish brown and mottlings of these colors-- jointed and showing many slips. In places the upper portion contains a considerable amount of sand, gravel or lime... Where lime predominates it closely simulates the Reynosa... manganese appears to be one of the characteristics of the clay wherever found. The upper portion of the beds is usually a sandstone... No fossils have been found in them.

The age of the formation is Pliocene, indicated by its position above the Lapara and below the Reynosa. It is exposed in Fayette County, where it lies unconformably on the Oakville. At the base of the clay, worn Cretaceous fossils are found in a bed of gravel. Deussen[70] gives a partial synonymy of the

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68. Dumble, E.T., The Cenozoic Deposits of Texas, Jour. Geol., vol.2, p. 560, 1894.

69. Ibid. p. 560-561.

70. Deussen, Alexander, Geology of the Coastal Plain of Texas West of Brazos River, U.S.Geol. Survey Prof. Paper 126, 1924, p. 100.

Lagarto clay in the Geology of the Coastal Plain of Texas West of Brazos River.

Fayette beds (included Yegua, Fayette, Frio, Oakville, Lapara, and Lagarto formations): Penrose, R.A.F., jr., A preliminary report on the geology of the Gulf Tertiaries of Texas from Red River to the Rio Grande: Texas Geol. Survey First Ann. Rept., pp. 47-58, 1890.

Navasota beds (included Lagarto clay and Oakville sandstone): Kennedy, William, Report on Grimes, Brazos, and Robertson Counties: Texas Geol. Survey Fourth Ann. Rept., pp. 9-15, 43-44, 1893.

Lagarto division: Dumble, E.T., Geology of southwestern Texas: Am. Inst. Min. Eng. Trans., vol. 33, pp. 60-63, 1903.

Lagarto beds: Dumble, E.T., The Cenozoic deposits of Texas: JOur. Geology, vol. 2, p. 560, 1894.

Dewitt formation (included Oakville, Lapara, and Lagarto formations): Deussen, Alexander, Geology and underground waters of the southeastern part of the Texas Coastal Plain: U.S.Geol. Survey Water-Supply Paper 335, pp. 74-76, 1914.

Pliocene(?) Series

Reynosa Formation

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In 1890, Penrose[71] described a limestone with pebbles and cobbles at the Reynosa. Later Hill[72] in 1891 called the remnants of a formation occupying the terraces 400 to 1000 feet above the Rio Grande the Uvalde formation. Dumble[73] in

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71. Penrose, R.A.F., jr., Report of Geology for Eastern Texas, Texas Geol. Survey, First Ann. Rept., 1890, p. 57.

72. Hill, R.T., Notes on the Geology of the Southwest, Am. Geologist, Vol. 7, 1891, pp. 367-368.

73. Dumble, E.T., The Cenozoic Deposits of Texas, Jour. Geol., vol. 2, 1894, p.560.

1894 called a series of deposits froming a plateau between the Nueces and Rio Grande Rivers the Reynosa formation. Due to priority of use the name Reynosa was adopted and Uvalde abandoned. The deposits lie unconformably on beds from upper Cretaceous to middle Pliocene in age. They are probably late Pliocene in age. The formation consists characteristically of gravel from one to five and six inches in diameter. This gravel is composed of many constituents, chiefly quartz, flint, jasper, chert, orthoclase, and other fragments of granitic rock, with some silicified wood, in the valley of the Colorado River. Fossils have not been found. The thickness of the formations varies from nothing to 600 feet on the Colorado. Generally it is found as a veneer over the older formations.

Subsurface Geology

The determination of the section for this county was based on a study of samples and well logs found in the Bureau of Economic Geology. The following wells in the county appear to afford the sections given below. The determination of the contacts of the formations of the English #1, English #3, Walter #1, Foerster #1, and Russek #1 were based mainly on work done by Ivan J. Fenn of the Bureau of Economic Geology in 1929-1930. The section shown in the Muldoon Water Well was determined by Alexander Deussen.[74] The log as he published it is given below. The work on the Kerr #2 was done by the writ r and the description of the samples are given as a type well of the county.

Section shown by the wells

Bristol Oil and Gas Company's English #1, 7 miles south of Smithville, Bastrop County.

	Depth From- Feet	To	Thickness Feet
Surface	0-	18	18
Yegua	18-	315	297
Cook Mountain			
Crockett	315-	815	500
Sparta	815-	945	130
Mount Selman			
Washes	945-	1300	355
Queen City	1300-	1370	70
Reklaw	1370-	1950	580

74. Deussen, Alexander, The Geology of the Gulf Coastal Plain of Texas West of Brazos River, U. S. Geol. Survey Prof. Paper 126, 1924, pp. 86-87.

Bristol Oil and Gas Company' English #3, 5 miles south of Smithville, Bastrop County.

	Depth From Feet	To	Thickness Feet
Surface	0-	23	23
Yegua	23-	340	317
Cook Mountain			
Crockett	340-	820	480
Sparta	820-	945	125
Mount Selman			
Weches	945-	1295	350
Queen City	1295-	1380	85
Reklaw	1380-	2015	636
Carrizo	2015-	2210	195
Wilcox	2210-	3283	1073

McClanahan and Stubbs, Walter #1, 1 mile south of Muldoon, Fayette County.

	Depth From- Feet	To	Thickness Feet
Surface	0-	15	15
Jackson			
Fayette	15-	405	390
Yegua	405-	930	525
Cook Mountain			
Crockett	930-	1335	405
Sparta	1335-	1495	160
Mount Selman			
Weches	1495-	1850	355
Queen City	1850-	2035	185
Reklaw	2035-	2151	116

Fayette Oil Company's Foerster #1, southwest of Muldoon, Fayette County.

	Depth From Feet	To	Thickness Feet
Surface	0-	10	10
Catahoula	10-	110	100
Jackson			
Fayette	110-	1000	890
Yegua	1000-	1460	460
Cook Mountain	1460-	1883	223

Russek #1, B.L.Coleman driller, located near Schulenberg, Fayette County.

	Depth From- Feet	To	Thickness Feet
Surface	0-	12	12
Lagarto	12-	90	78
Oakville	90-	680	590
Catahoula	680-	1155	475
Jackson			
Frio	1155-	1665	510
Fayette	1665-	2581	916

Muldoon Water Well, Muldoon, Fayette County.

	Depth From- Feet	To	Thickness Feet
Surface	0-	15	15
Jackson			
Fayette	15-	201	186
Yegua	201-	795	594
Cook Mountain	795-	1500?	705
Mount Selman	1500-	1744	244

Muldoon Oil and Gas Development Company's Kerr #2 Muldoon, Fayette County.

	Depth From- Feet	To	Thickness Feet
Surface	0-	15	15
Jackson			
Fayette	15-	582	567
Yegua	582-	901	319
Cook Mountain			
Crockett	901-	1364-	463
Sparta	1364-	1594	230
Mount Selman			
Weches	1594-	1823	229
Queen City	1823-	2108	285
Reklaw	2108-	2640	532
Carrizo	2108-	3278	638
Wilcox	3278-	3505	227

Log of well of John Kerr, at Muldoon, Texas

(Description of samples by Alexander Deussen.)

	Thickness Feet	Depth Feet
Quarternary------------------------------	15	15
Fayette sandstone:		
Yellow-brown fine-grained slightly argillaceous sandstone----------	15	30
Lignite----------------------------------	4	34
Bluish-gray sandy clay------------	36	70
Light bluish-gray friable argillaceous, very fine-grained sand---	10	80
Green calcareous fossiliferous shale----------------------------	120	200
Blue lim stone with some fine grains of pyrite----------------------	$1\frac{1}{4}$	$201\frac{1}{4}$
Yegua formation:		
Green calcareous fossiliferous shale----------------------------	$138\frac{3}{4}$	340
Greenish-gray glauconitic marl; fossiliferous------------------	1	341
Green-black sandy clay: slightly fossiliferous------------------	59	400
Tough, plastic, green-brown slightly fossiliferous shale-------------	100	500
Tough, plastic, green-brown slightly fossiliferous shale; slightly calcareous--------------------	30	530
Green-black fossiliferous shale----	25	555
Green-black slightly fossiliferous shale-------------------------	39	594
Green-gray argillaceous sand; only slightly calcareous-------------	45	639
Green black calcareous sand; contains very fine-grained quartz with a with some mica and possibly some glauconite (?)-------------	1	640
Green-gray slightly calcareous, argillaceous sand---------------	111	751
Bluish-gray fine-grained slightly argillaceous sand---------------	44	795
Cook Mountain formation (?):		
Samples represent a number of distinct beds---------------------	55	850
Green gray slightly sandy fossiliferous shale-------------------	50	900
Samples indicate two separate beds; one is a nonfossiliferous compact lignitic, noncalcareous shale; the other is a plastic, sticky, dark-green fossiliferous		

Cook Mountain formation(?)-- continued	Thickness Feet	Depth Feet
shale	99	999
Green calcareous fossiliferous plastic shale	91	1090
Green fossiliferous calcareous shale with poorly preserved fossils	40	1130
Dark-green calcareous calcareous plastic shale	45	1175
Green calcareous fossiliferous plastic shale	235	1225
Dark-green calcareous plastic fossiliferous shale	75	1300
Dark-green calcareous plastic fossiliferous shale; green-brown-fine-grained loose, slightly calcareous sand at 1340 feet	65	1365
Green calcareous fossiliferous shale	45	1410
Fossilif rous shale	15	1425
Green-black fossiliferous shale	75	1500
Mount Selman formation (?):		
Record missing	40	1540
Brown porous fine-grained sand; slightly calcareous, probably water-bearing	20	1560
Sample lacking	15	1575
Fossiliferous shale	100	1675
No record	27	1702
Green-black calcareous fossiliferous shale	28	1730
Brown lignitic shale	14	1744

(Copied as original in Professional Paper 126 p. 87, from 1175 to 1744)

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75. Deussen, Alexand r, Geology of the Coastal Plain of Texas West of Brazos River, U.S.Geol. Survey. Prof. Paper 126, 1924, pp. 86-87

Sample descriptions of the Muldoon Oil and Gas Development Company's Kerr #2, Muldoon, Fayette County, Texas.

	Depth Feet
Gray sand and sandy clay and shale. Abundant quartz and chert pebbles, pyrite nodules. Lignite, glauconite, and limonite. No macrofossils. Gyroidina sp., Quinqueloculina sp., Eponides guayabalensis, Ceratobulimina sp.	521
Gray sand with clay and shale. Chert and quartz pebbles. Pyrite nodules. Shell fragments, mainly gastropods. Eponides yeguaensis,	564
Gray sandy and laminated shale, gray sand. Chert and quartz pebbles. Pyrite nodules. Lignite, limonite, glauconite. Few macrofossils, fragments of pelecypods.	571
Gray sand, and gray sandy shale, sandier than above. Chert and quartz pebbles. Pyrite nodules. Lignite, limonite, glauconite. Few macrofossils, fragments of pelecypods. Siphonina sp.	582
Gray sand, gray sandy shale, and greensands. Chert and quartz pebbles. Pyrite nodules. Lignite limonite, glauconite, Few macrofossils. Shark's tooth.	608
Gray sand and shale, sandier than at 608. Chert and quartz pebbles. Pyrite nodules. Limonite, glauconite, and abundant lignite. Few Macro-fossils-fragments	627
Same as 627. Lignite abundant.	650
Same as 627.	672
Same as 627.	694
Samd as 627.	712
Same as 627.	734
Same as 627.	756
Same as 627.	778
Same as 627. Calcareous pebbles.	798

	Depth Feet
Same as 627.	820
Same as 627.	860
Same as 627. Less sandy and less lignitic.	901
Gray sand and laminated shale. Chert pebbles and quartz. Pyrite nodules. Few macrofossils-- mainly fragments of pelecypods. Turritella?	942
Gray sandy, non-calcareous shale and gray sand. Chert and quartz pebbles. Pyrite nodules. Lignite, and glauconite. Shell fragments few. No macrofossils.	1043
Bit sample. Gray, calcareous, glauconitic, slightly snady shale. Calcareous nodules. Shell fragments. Asterigerina sp., Eponides sp., Siphonina sp., Gyroidina sp.	1048
Gray sand, shale fragments. Small quartz and chert pebbles. Pyrite nodules and cubes. Muscovite. Shell fragments. Dentalium minustriatum, worn gastropod, Nonion sp., Eponides guayabalensis, Bolivina, Arenaceous forms.	1109
Gray sand and shale. Chert pebbles. Shell fragments, Pyrite, glauconite, limonite, and lignite. Dentalium minustriatum, Dentalium sp., Cadulus sp., Turbinolia sp. Volutilithes? sp., Terebra sp., Phos texanus, Turritella sp., Venericardia planicosta, broken form of a plano-spiral ornamented gastropod, Eponides guayabalensis	1153
Gray, slightly sandy, calcareous, shale. Rather large pebbles of chert. Quartz pebbles. Residue: Quartz sand, glauconite, pyrite, some lignite, shell fragments. Dentalium minustriatum. Asterigerina sp. Siphonina sp., Gyroidina sp., Quinqueloculina sp., Ceratobulimina sp.	1170
Gray sandy, slightly calcareous shale, sand. Chert and quartz pebbles. Pyrite nodules. Glauconite. Shell fragments. Asterigèrina sp. Eponides guayabalensis	1195
Gray clay--greensand. Glauconite, pyrite, chert. Shell fragments. Turbinolia sp. Nucula sp., Corbula sp., Natica sp., Venericardia alticostata, Dentalium minustriatum, Turritella sp., Phos texanus, Trinacria cf. declivis, T. pulchra, Volutilithes sp. Latirus moorei, Asterigerina sp., Eponides guayabalensis	1217

	Depth Feet
Gray clay--greensand. Glauconite, pyrite, quartz and chert pebbles. Shell fragments. Turbinolia sp., Dentalium minustriatum, Phos texanus, Natica sp., Turritella spp. Volutilithes spp. Gastropod,worn	1236
Gray, glauconitic shale, greensand. Quart and chert pebbles. Pyrite, limonite, glauconite. Dentalium minustriatum, Trinacria sp., Pleurotoma sp., Turbinolia sp., Trinacria pulchra, Natica spp. Ringula sp. Asterigerina sp., Eponides guayabalensis	1258
Gray glauconitic clay, green-sand. Chert fragments, pyrite nodules, shell fragments. Fusus harrisi, Corbula smithvillensis, Pleurotoma sp., Nyctilochus (Tritonium) sp. Corbula deusseni, Asterigerina sp. Ceratobulimina sp.	1280
Gray sandy shale, and clay. Greensand. Quartz and chert pebbles. Limonite, pyrite, glauconite. Dentalium minustriatum, Phos texanus, Mesalia sp., Cerithium sp. Fusus harrisi, Terebra cirvilineata?, Turitella sp., Trinacria pulchra, Corbula smithvillensis, Latirus moorei, Natica sp. Turbinolia sp., Eponides guayabalensis	1292
Gray clay, sandy, greensand. Chert fragments. Pyrite nodules. Glauconite, limonite. Dentalium minustriatum, Venericardia planicostata, Turbinolia sp., Cadulus sp., Asterigerina sp.	1302
Sandy, gray laminated, slightly calcareous shale. Pyrite nodules. Chert fragments. Glauconite. Shell fragments. Venericardia alticostata, Turbinolia sp., Natica sp., Dentalium minustriatum, Turritella sp., Terebra sp., Latirus sp.?, Phos texanus, Trinacria pulchra, Volutilithes sp., Pleurotoma sp., Asterigerina sp., Eponides guayabalensis, orbitoid foram.	1320
Sandy gray, calcareous shale, jasper, quartz, Shell fragments. Pyrite nodules. Glauconite, limonite. Dentalium minustriatum, Turitella sp., Cadulus sp., Pleurotoma sp. Phos texanus, Natica sp., Trinacria pulchra, Latirus moorei	1364
Gray sand, shale. fragments. Limonite, pyrite. Glauconite, lignite. Shell fragments. Cadulus sp., Pleurotoma ? sp., Pleurotoma sp., Natica sp., Turitella sp., Asterigerina sp., Eponides guayabalensis.	1386

Depth
Feet

Gray sand with shale fragments. Ferruginous stained quartz grains. Limonite, pyrite, glauconite. Shell fragments. Natica sp. Pleurotoma? sp., Adeorbis sp., cf. sylvaeruptus or liniferus	1404
Gray sand, non-calcareous. Glauconite, pyrite limonite. Dentalium minustriatum, Dentalium sp., Cadulus sp., Natica arata, worn gastropod of Pleurotoma type	1426
Gray sand, non-calcareous, pyrite, glauconite, limonite, Shell fragments. Dentalium minustriatum, Turbinolia sp., Pleurotoma sp., Epitonium (Scala) cf. exquisita; Terebra sp., Latirus sp., Pleurotoma cf. potomacensis, Orbitoid form of foram. Eponides guayabalensis	1470
Gray calcareous sand; shale, chert, and jasper fragments. Residue: glauconite, pyrite, lignite, Fish otoliths, Corbula sp., Corbula smithvillensis, Pleurotoma sp., Dentalium minustriatum, Pleurotomella sp., Cancellaria sp., Latirus moorei, Cadulus sp., Phos texanus, Volutilithes sp.,	1492
Gray non-calcareous sand, chert and shale fragments. Shell fragments. Residue: pyrite, glauconite, lignite, medium angular quartz. Shell fragments. Dentalium minustriatum, Pleurotoma sp., Natica limula, Natica sp., Cadulus sp., Volutilithes cf. limopsis, Trinacria pulchra, Latirus moorei, Quinqueloculina sp., Asterigerinan sp., Gyroidina sp.,	1510
Gray sand, non-calcareous, shale fragments. Residue: glauconite, lignite, pyrite, shell fragments. Fish otoliths, Dentalium minustriatum, Cadulus sp., Natica arata, Turbinolia sp., Natica sp., Trinacria pulchra, Corbula deusseni, Worn pelecypod, Bryzoa	1532
Gray sand, shale fragments. Glauconite, pyrite, mica. Dentalium minustriatum, Nucula sp., Natica arata, Corbula sp.; Pleurotoma sp.	1554-1572
Sand, glauconitic, shale, some clay. Pyrite nodules. Very many shell fragments. Fish otoliths, Venericardia alticostata? Turbinolia sp., Natica spp., Cerithium sp., All worn specimens.	1594
Glauconitic, calcareous clay, shale, sand. Siderite present. Shell fragments. Pyritized fossils. Dentalium minustriatum, worn Volutilithes sp., Turbinolia sp.	1616

Glauconitic clay, calcareous, sand. Fragment of shells., Latirus moorei, Turitella nasuta, Natica sp., Turbinolia sp., Cerithium sp., Asterigerina sp. 1638

Glauconitic clay, sand. Shell fragments. Turbinolia sp., Fragments of Venericardia sp., Natica sp., Cerithium sp., 1657

Glauconitic clay, shale, some sand. Fish tooth. Dentalium minustriatum, Turbinolia sp., Volutilithes cf. petrosus, Natica spp., Trinacria pulchra, Trinacria cf. declivis, Nucula mauricensis, Natica limula 1680

Indurated gray, non-calcareous clay. Some sand. Natica sp; Turbinolia sp., Natica cf. dumblei, Volutilithes cf. petrosus, Terebra sp., Pleurotoma sp., Trinacria pulchra, Latirus moorei 1702

Glauconitic sand. Abundant shell fragments. Dentalium minustriatum., Dentalium sp., Turbinolia sp., Natica cf. dumblei, Trinacria pulchra, Trinacria cf. declivis, Latirus moorei, Volutilithes cf. petrosus, Ceratobulimina 1724

Glauconitic shale with sand. Jasper fragments. Shell fragments. Fish teeth-- fragments. Dentalium minustriatum, Trinacria declivis, Nucula sp., Venericardia alticostata, Volutilithes sp. 1742

Samd as 1742. Turitella sp., Turbinolia spl, Dentalium minustriatum, Cadulus sp., Eponides guayabalensis, Siphonina spp. 1764

Shale calcareous with glauconite. Shell fragments. Dentalium minustriatum. Fragments of Turritella sp. Pyrite 1786-1823

Gray calcareous sand. Shale fragments. Residue: medium angular quartz, gray chert, glauconite, pyrite, shale. Fish otoliths, Turritella, Rotalia beccariformis. 1845-1867

Sand gray, micaceous, calcareous. Quartz grains of two sizes. Pyrite, muscovite, glauconite-- not abundant, some lignite. Chert. Shell fragments. Dentalium minustriatum. Natica sp., juvenile whorl of a gastropod 1890-1932

Gray sand, micaceous, Residue: angular and rounded quartz, pyrite, limonite, glauconite. Shell

Depth
Feet

fragments. Natica sp., Turbinolia sp., Quinqueloculina sp., Nonion cf. incisa, Rotalia beccariformis, Eponides guayabalensis 1954

Brown shale. Residue: angular quartz, glauconite. Shell fragments, not abundant. Rotalia beccariformis, Epistomina cf. partschiana 1965

Sand gray, glauconitic. Shell fragments. Residue; quartz grains of two sizes, angular to rounded. glauconite, lignite, pyrite, limonite, shell fragments. Turbinolia sp. Natica sp., Quinqueloculina sp., Siphonina sp., Eponides guayabalensis?, Arenaceous foram. 1976

Sand gray, glauconitic. Residue: angular quartz, glauconite, pyrite, hematite, limonite, sericitized mica, Shell fragments. Dentalium minustriatum, Gyroidina sp. cf. subangulata, Siphonina sp., Asterigerina sp. 1996

Glauconitic shale with many shell fragments. Residue: fine angular quartz, pyrite, glauconite, lignite, magnetite, Shell fragments. Natica sp., Dentalium minustriatum, Turbinolia sp., Siphonina wilcoxensis? 2006

Sand gray, non-calcareous, Residue: angular and rounded quartz, very fine, pyrite, glauconite, lignite, limonite, hematite?, shell fragments. Dentalium minustriatum, Dentalium sp., Rotalia beccariformis, Asterigerina sp. 2019

Sand gray, non-calcareous. Chert pebbles. Residue: angular quartz, glauconite, pyrite, Macrofossils not abundant. Asterigerina, Ceratobulimina sp., Fragment of Natica? 2042

Sand gray, non-calcareous. Residue: subangular quartz, pyrite, glauconite, quartz, pyrite cubes. Dentalium minustriatum, Asterigerina sp., Rotalia beccariformis, Eponides sp. 2085

Sand, gray, non-calcareous. Residue: quartz, angular to rounded, glauconite, muscovite, pyrite, some lignite. Jasper pebbles and pyrite nodules. Shell gragments. Asterigerina sp., Siphonina sp., worn gastropod. 2108

Sand, glauconitic, calcareous. Residue: quartz, glauconite, pyrite, lignite, limonite, muscovite. Shell fragments. Dentalium minustriatum. Olivia? Natica sp.,

	Depth Feet
Asterigerina sp., Quinqueloculina	2131
Glauconitic sand. Residue: Quartz, glauconite, limonite, pyrite, Shell fragments. Turbinolia sp., Venericardia sp., Dentalium minustriatum, Tirris sp., Turritella sp., Siphonina sp.	2151
Glauconitic sandy shale. Residue: very fine quartz, glauconite, limonite, pyrite, calcite, The quartz is iron-stained. Shell fragments. Turbinolia sp., Ostracods, Natica sp., Venericardia planicostata, Dentalium minustriatum, Turitella sp.	2174
Shale and sand, gray, non-calcareous. Residue: sub-angular to rounded quartz, pyrite, glauconite, limonite, chert and limestone fragments. Pyrite nodules Shell fragments. Ostracods, Dentalium minustriatum	2195
Sand glauconitic, calcareous. Residue: quartz glauconite, pyrite, limonite. Shell fragments. Dentalium sp., Asterigerina sp. Siphonina sp., worn gastropod	2218
Sand glauconitic. Residue: Glauconite with quartz, limonite, pyrite, hematite, mica--muscovite. Chert and jasper fragments. Pyrite nodules. Shell fragments. Asterigerina,sp., Rotalia beccari, Siphonina sp.	2238
Sand glauconitic. Residue: glauconite with quartz, limonite, pyrite. Shell fragments. Dentalium minustriatum, Natica spp., Nonion cf. scapa, Gyroidina sp., Siphonina sp.	2251
Sand gray, calcareous. Residue: glauconite with quartz, limonite, pyrite, shell fragments. Natica sp., Turritella sp., Rotalia sp., Gyroidina sp., Asterigerina sp.	2270
Shale and clay, variously calcareous, glauconitic. Residue: Glauconite-- quartz, mica, lignite, hematite, small amount of pyrite. Dentalium minustriatum. Asterigerina sp.	2295
Glauconitic shale. Iron stained quartz, chert pebbles. Shell fragments. Residue: glauconite, very fine quartz, pyrite, limonite, mica, minute gastropods, Nonion cf. scapa, Natica sp.,	2341
Glauconitic shale. Residue: Glauconite, quartz pyrite, chert pebbles. Shell fragments. Natica sp., Dentalium minustriatum, Siphonina sp., Quinqueloculina sp.	2364

Depth
Feet

Shale, snady, slightly cacoareous. Residue: Glauconite, quartz, jasper, pyrite, muscovite, limonite, shell fragments. Asterigerina sp., Gyroidina sp. 2384

Shale, gray, calcareous. Residue: glauconite, with quartz, pyrite, limonite. Chert and quartz pebbles. Shell fragments. Turritella sp., Gyroidina sp. 2389

Shale; quartz and jasper fragments. Residue: quartz, glauconite, pyrite. Flint fragments, pyrite nodules. Ostracods, Corbula sp., Candellaria? Natica sp., Venericardia alticostata, Turris sp., Siphonina claibornensis, Quinqueloculina sp., Dentalium minustriatum 2410

Shale, slightly calcareous. Residue:quartz, pyrite, glauconite, mica. Natica sp., Venericardia planicostata, Nassa sp.?, Siphonina sp., Ostracod 2433

Shale, gray, calcareous. Residue: very fine quartz, and equal amount of glauconite. Pyrite, ironstained quartz. Shell fragments. Dentalium minustriatum, Natica sp., Siphonina sp., Asterigerina sp. 2456

Calcareous shale. Residue: Angular quartz, glauconite, pyrite, limonite, chert pebbles. Shell fragments. Pleurotoma sp., Siphonina, cf. claibornensis. Gyroidina sp. 2517

Sandy, calcareous shale. Residue: mainly glauconite, quartz, pyrite, limonite. Glauconite casts. Pebbles of quartz. Pyrite nodules. Shell fragments. Eponides guayabalensis, Natica sp., Ostracods, Turbinolia sp., Asterigerina sp., GYroidian sp., Arenaceous forms 2535

Sand, white with shale, non-calcareous. Residue: rounded and sub-angular frosted quartz, pyrite, glauconite, hematite. Some of the quartz is ironstained. The pyrite has latered.Shell fragments. Natica sp., Turritella sp., Rotalia cf. beccariformis 2640

Sand, gray, non-calcareous, with jasper and pyrite fragments. Residue: rounded to sub-angular quartz, pyrite, limonite, glauconite, muscovite, shell fragments. Nonion cf. scapa. Gyroidina soldani? Rotalia beccariformis. 2659

Sand, gray, non-calcareous. Residue: slightly angular to rounded quartz. pyrite, glauconite, limonite lignite. Shell fragments. Nonion sp., Dentalium minustriatum. 2690

Depth
Feet

Sand, gray, non-calcareous. Residue: angular and rounded quartz of two sizes, glauconite, pyrite, limonite, Quartz iron stained. Larger quartz grains well rounded. Pyrite nodules. Jasper pebbles. Natica sp., Corbula sp., Asterigerina sp. Gyroidina sp. 2723

Sand--jasper and flint pebbles and pyrite nodules. Residue: sub-angular to rounded, frosted quartz, with some iron stained grains, pyrite, limonite muscovite, and glauconite. Ostracods, Venericardia sp., Dentalium sp., Natica sp. Pleurotoma sp. Asterigerina sp. 2738

Sand, gray-- calcareous, with jasper, flint and pyrite fragments. Residue: angular to sub-angular, rounded, frosted quartz, pyrite, glauconite, zircon? Shell gragments. Turbinolia. Dentalium sp., Asterigerina sp. 2748

Shale, sandy, calcareous. Pyrite nodules. Jasper pebbles. Residue: rounded pitted quartz, pyrite, glauconite; pyrite badly altered to limonite. Shell fragments. Muscovite, Natica sp., Asterigerina sp., Nonion sp. 2760

Gray sandy shale. Residue: quartz, angular and rounded, pitted, two sizes. Glauconitie, pyrite, limonite, chlorite, lignite, shell fragments. Natica sp. 2790

Sand and shale, slightly calcareous with pyrite nodules and jasper and quartz pebbles. Residue: angular to rounded quartz, pyrite, muscovite, limonite, magnetite, finely disseminated lignite. Asterigerina sp. 2826

Sand, non-calcareous, jasper and flint pebbles. Residue: sub-angular to rounded pitted quartz, pyrite, glauconite, some lignite, limonite, muscovite, shell fragments. 2849

Sandstone, non-calcareous. Residue: subangular to rounded quartz, pyrite, glauconite, limonite, Some finely disseminated lignite. Shell fragments. Asterigerina 2872

Shale, sandy, calcareous, slightly. Quartz and jasper pebbles, pyrite nodules. Residue: angular to rounded pitted quartz, pyrite, glauconite, limonite, muscovite, magnetite, lignite, limestone fragments. Turbinolia sp. Corbula? sp. 2895

Depth
Feet

Gray sand, non-calcareous. Residue: sub-angular quartz, glauconite, pyrite, limonite, biotite, some lignite. Ostracods, Asterigerina,sp., Gyroidina sp., Rotalia sp. 2900

Sand, gray,non-calcareous. Residue: angular to rounded, frosted, pitted quartz. Pyrite, limonite, glauconite, jasper, shell fragments. Dentalium minustriatum 3030

Angular quartz sand with pyfite, glauconite, limonite, some of the quartz grains covered with limonite. Rounded quartz pebbles and small concretions of pyrite. Natica and ;leurotoma? Fragments of pelecypods. Asterigerina sp. Turritella 3049

Sand, gray, non-calcareous. Residue: sub-angular to rounded frosted quartz, pyrite, limonite glauconite, muscovite. Shell fragments. Quinqueloculina sp. 3070

Sandy shale, non-calcareous. Residue: fine and medium sand grains of quartz; pyrite, biotite, glauconite, limonite, nodules of pyrite,and glauconite. Ostracod, Shell fragments. Corbula? Nonion?sp. 3121

Sandy shale, calcareous. Residue: angular to rounded and pitted quartz of two zixes. Pyrite, limonite, glauconite. 3128

Sandy shale, slightly calcareous. Residue: angular to sub-angular quartz, pyrite, glauconite, limonite, shell fragments. S nd of two sizes, very fine and medium. Pyrite showas very good cubes. Flint pebbles. Asterigerina sp. 3144

Sandtone, friable. Sample residue: fine grained sand with larger quartz and pyrite grains. Limonite, mica, glauconite, gypsum?, biotite 3182

Shale, calcareous, pyrite nodules, and jasper pebbles. Residue: angular to rounded pitted quartz, pyrite, limonite, glauconite, some lignite, muscovite, Nonion cf. scapa. 3230

Sand and shale, sub-angular to rounded quartz grains. Pyrite, limonite, jasper, glauconite. Shark tooth, Natica sp., Dentalium minustriatum, Rotalia beccariformis, Quinqueloculina sp., Eponides guayabalensis 3237

Depth
Feet

Shale with sand, calcareous. Residue: limestone, and jasper fragments. Pyrite nodules. Shell fragments. Quartz, anguaer to rounded. Very small amount of lignite. Shell fragments. 3260

Sand, s ightly calcareous, rose quartz, jasper fragments, pyrite nodules. Residue: rounded to angular quartz, glauconite, pyrite, limonite, biotite. Lignite not abundant. Shell fragments. Dentalium minustriatum 3278

Sandy shale, slightly calcareous. Sand grains of quartz, slightly rounded and itted to angular. Glauconite, pyrite, limonite, muscovite, biotite, pyrite nodules, jasper and limonite pebbles. Shell fragments, magnetite. Asterigerina? 3280

Core. Sandstone, gray, calcareous, lignitiferous, biotite, glauconite, muscovite. 3281

Friable sandstone, gray, non-calcareous, fine-even grained, little silt. Iron stained quartz, glauconite, biotite, muscovite, and few grains of limestone. Lignite if present is very finely disseminated. 3284

Sand, gray, slightly calcareous. Residue: angular to rounded quartz, two sizes. Pyrite, limonite, hematite, glauconite, lignite. Natica sp., Asterigerina sp. 3297

Sand, gray, calcareous. Residue: rounded frosted quartz, pyrite, limonite, glauconite, muscovite, lignite, shell fragments. Asterigerina sp. Dentalium? 3322

Shale, sandy, gray, calcareous. Residue: quartz, rounded, pyrite, limonite, glauconite, biotite, lignite, muscovite. Natica sp., Corbula, Gyroidina sp., Rotalia sp., 3345

Shale gray, non-calcareous. Residue: quartz rounded, frosted, pitted. Pyrite, glauconite, limonite, Jasper pebbles and pyrite nodules. Pleurotoma sp., Shark tooth. Nonion sp. 3363

Shale, sandy, non-calcareous. Residue: angular to rounded pitted quartz, pyrite, limonite, glauconite, hematite, some lignite. Pyrite nodules. Quartz and jasper pebbles. Corbula sp., Asterigerina sp., Rotalia sp. 3386

Depth
Feet

Sandy shale, non-calcareous with jasper and pyrite fragments. R sidue: angular quartz, glauconite, pyrite, shell fragments, limonite, biotite, muscovite, Natica sp., Dentalium mimustriatum 3405

Limestone with glauconite, fossiliferous; pyrite nodules, limonite, some lignite. 3406

Core. Clay. Residue: angular to rounded quartz, pyrite, glauconite 3406

Sand, with pyrite and jasper fragments. Shale fragments. Residue: very fine angular quartz., Glauconite, pyrite, muscovite, limonite, lig ite. 3430

Sand, gray, slightly calcareous, pyrite, chert, limonite, and limestone pebbles. Residue: very fine rounded to sub-angular quartz, glauconite, biotite, pyrite, lignite 3475

Sandstone, white friable, non-calcareous with a residue of fine angular quartz, glauconite, iron-stained quartz, some lignite, micaceous mineral, Lignite finely disseminated; Sandy shale with 3
residue of fine angular quartz, muscovite, lignite, limestone fragments, biotite. 3505

Conclusion

A table showing a comparison of the thicknesses of the formations in a north-south direction in the different wells is given below.

	English #3	English #1	Kerr #2	Muldoon Water	Walter #1	Foerster #1	Russek #1
Lagarto							78
Oakville							590
Catahoula						100	475
Frio							510
Fayette			567	201	390	890	916
Yegua	317	297	319	594	525	460	
Crockett	480	500	463		405	223	
Sparta	125	130	230	705	160		
Weches	350	355	299	? 244	355		
Queen City	85	70	285		185		
Reklaw	635	580	532		116		
Carrizo	195		638				
Indio	1073		227				

X

From this table it may be seen that the variations in thickness are not uniform; the thickening of all the formations is not from north to south. The Indio cannot be judged as the wells did not penetrate the complete section. Of the Eocene formations, the Carrizo, Fayette, and Yegua thicken to the south; the Reklaw and Crockett thin to the south; the Queen City and Sparta show a thickening and then a thinning. The Frio is present in one well, probably thinning out in a wedge-shaped manner. Of the upper Tertiary formations, the Catahoula, Oakville, and Lagarto are at the surface, showing a slight thickening to the south.

These variations in thickness may be due to several things: inaccuracy in logging and determining the formation contacts, crooked holes, faults causing a local duplication of strata, or actual differences in the formations.

The deposits are mainly near shore or fresh water facies, which show a rapid variation in thickness and lithology. Fossils are variably present; in some places none are found; in others an abundant fauna is present. Lignite is found throughout the section practically, and is especially abundant in the Fayette, Yegua, upper part of the Sparta, Queen City, and Indio formations. Galuconite is very common in Eocene formations, particularly in the Crockett, Weches, and Reklaw. Pyrite is a common heavy mineral constituent; the nodules vary from microscopic cubes to rather large ($\frac{1}{4}$-$\frac{1}{2}$ inch) nodular condretions.

A section in Fayette County as determined from a study of the wells and surface samples is shown in the table on Plate III.

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Plate I

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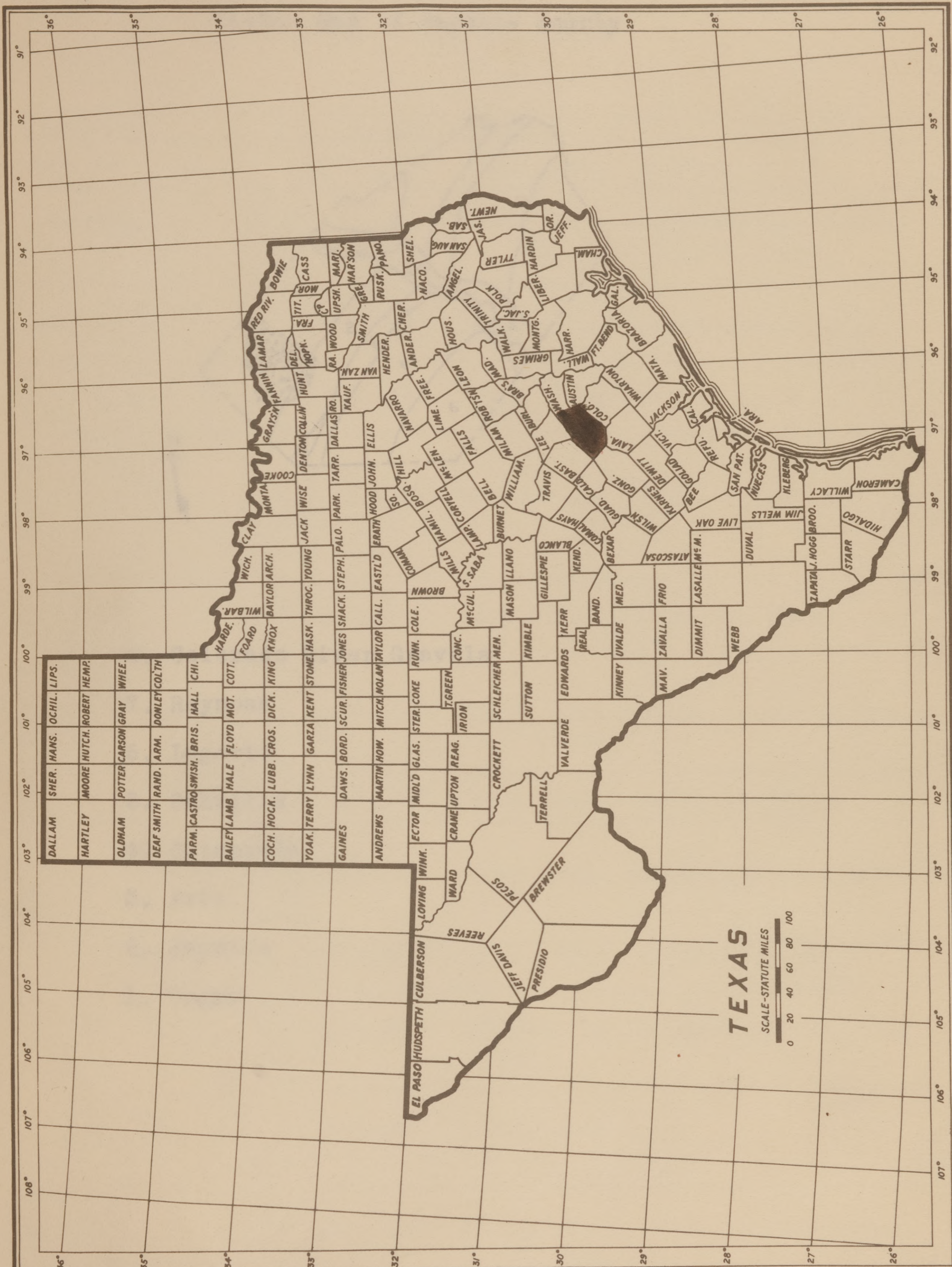

July 1, 1917

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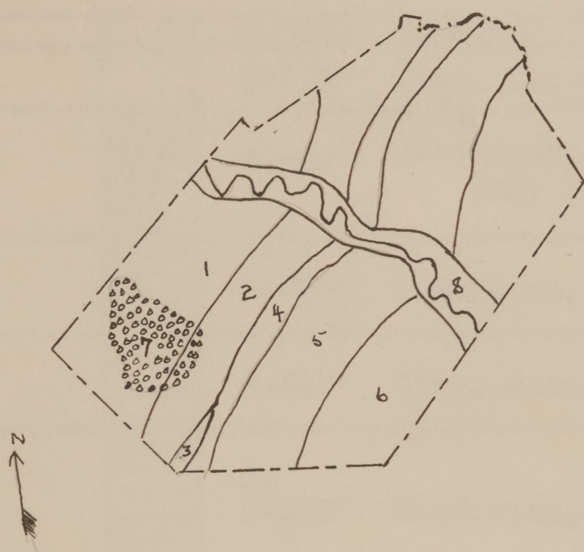
Map of Texas showing the location of Fayette County

Sketch Map of Fayette County



8. Colorado River Gravels

7. Reynosa

6. Lagarto

5. Oakville

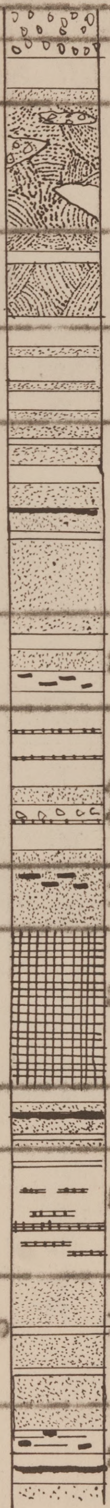
4. Catahoula

3. Frio

2. Fayette

1. Yegua

Section in Fayette County



Group	Sub-group	Formation	Thickness	Lithology
		Reynosa	0- 20'	Gravels
		Lagarto	0-100'	Clay, sand, gravel
		Oakville	0-700'	Sandstone, Cross-bedded, lenses clay and conglomerate.
		Catahoula	0-500'	Sandstone, cross-bedded, clay
Jackson		Frio	0-510'	Clay, concretions, sand
Jackson		Fayette	0- 0-250'	Sandstone, clay, lignit
Claiborne		Yegua	290-600'	Sand, Clay, lignitic clay
Claiborne	Cook Mountain	Crockett	400-500' 4	Clay, glauconitic, concretions, sand
Claiborne	Cook Mountain	Sparta	120-220'	Sand, Upper part lignitic.
Claiborne	Mount Selman	Weches	300-360'	Greensand, clayey glauconite
Claiborne	Mount Selman	Queen City	70-290'	Sand, Clay, lignite seams.
Claiborne	Mount Selman	Reklaw	530-640'	Glauconite and Glauconitic clay
Claiborne	Mount Selman	Carrizo	190-640'	Sand, Clay
		Wilcox	230-1070'	Sand, shale, clay, sandstone, lignite

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